The Public Value of Load Reductions in the California Market – Preliminary Results

by Rich Ferguson, Sierra Club, July 21, 1999

Introduction

In the California markets for electrical energy and ancillary services, prices are an increasing function of demand. Activities that reduce loads therefore reduce the costs for all other purchasers remaining in the market (see Figure 1). Based on market prices and quantities to date, historical supply curves can now be estimated with reasonable accuracy. This paper summarizes the work to date on the estimation of the sensitivity of prices to demand and estimates the total public savings that would have resulted from reductions in load during the twelve month period ending May 31, 1999.

These results indicate public annual savings per megawatt of baseload reduction to be approximately $650,000, which is three times the avoided cost of the power. It should also be noted that these public savings result from lower payments to sellers in the market, which has important implications regarding the administration of publicly funded activities which may be undertaken to achieve load reductions.

Data and Analysis

Initial analysis has been done on prices and quantities in the energy market operated by the California Power Exchange (CalPX) which are available on the CalPX website for every hour of every day since the opening of the market. Data for the months of September, 1998, and May, 1999, are shown in Figures 2 and 3, where price and quantity for each hour determine the position of a single point. By fitting a polynomial to the collection of points, a proxy supply curve for the month is obtained. (The curve for May was used for Figure 1.)

The sensitivity of prices to changes in load is given by the derivative of the supply curve, dP/dQ. Both price and sensitivity of prices to loads for the month of May 1999 are shown in Figure 4. With price sensitivity a known function, the decrease in price DP can be computed for a load reduction DQ by

$$\mathbf{DP = (dP/dQ)*DQ}$$

The remaining load Q (DQ is assumed small) is sold at a price reduced DP, and buyers in the market receive public benefits from the load reduction

$$\mathbf{Q*DP = Q*(dP/dQ)*DQ}$$

These savings are shown graphically in Figure 1 and are computed for a load reduction DQ equal to 1.0 MW during one hour in May, 1999, for which load was 20,000 and the market clearing price given by the supply curve was $24.98/Mwh. For this load, the price sensitivity given by the derivative of the supply curve was

$$\mathbf{dP/dQ = 0.0024234\ \$/Mwh/MW}$$

and the public savings for DQ = 1 MW are

$$\mathbf{Q*dP/dQ = 20{,}000 * 0.0024234 = \$48.47}$$

Summary of Results

The above process has been performed for each month, June 1998 through May 1999, and the public savings computed for each hour, with the following results:

Savings from One MW of Load Reduction				
PX unconstrained prices and quantities				
Month	Savings/MW			
Jun-98	46,000			
Jul-98	91,000			
Aug-98	115,000			
Sep-98	100,000			
Oct-98	40,000			
Nov-98	34,000			
Dec-98	74,000			
Jan-99	33,000			
Feb-99	21,000			
Mar-99	27,000			
Apr-99	33,000			
May-99	44,000		**Savings per average kilowatt-hour reduction**	
Total	**$658,000**		**$0.0751**	

As shown above, the public value (in addition to private benefits) which would have accrued in the last year from lower electricity prices resulting from a one megawatt reduction in baseload is $658,000, compared to the average cost of one megawatt-year (8760 megawatt-hours) of approximately $219,000. This is equivalent to public savings of $0.075 per average kilowatt-hour of reduction, compared to an average energy cost of $0.025/kwh. Clearly, load reductions have significant public value, even when spread evenly throughout the year.

It should be remembered that these savings are not the result of high prices but rather by the combination of large loads and *sensitivity* of prices to load. It should also be noted that although these two months accounted for one-third of the public savings, the value of load reductions during the other ten months is non-trivial, amounting to two-thirds of the total.

Implications for Public Policy

Work is continuing to consider the cost of ancillary services and other related costs. These additional costs represent approximately 10% of energy costs and may increase the value of load reductions significantly. It might also be possible to compute the public savings in such a way as to capture the benefits of load reductions that relieve transmission congestion. Regardless of numerical details, the way in which market clearing prices are established *always* results in prices that are monotonically increasing with load. Thus there will always be monetary public benefits associated with reductions in load.

It is unreasonable to expect individual consumers to reduce load simply to provide benefits for the public at large. One might hope that the private benefits available from load reductions or load shifting would be large enough to provide incentives for private actions from which the public would benefit. However, there are significant market barriers that interfere with individual consumers' interest and ability to capture the private savings of load reductions:

* Without time of use metering and tariffs, consumers' load reductions cannot capture the full private value, and individuals' share of public benefits is negligible;
* Real-time rates introduce additional fixed costs and significant volatility in energy costs that many consumers would rather avoid;
* Capturing even private benefits from load reductions requires a level of attention from consumers with associated costs, real or perceived, that are often considered not cost-effective.

Capturing the public benefits of load reductions requires action by the public. To this end, California's restructuring legislation established a "public goods charge" (PGC) to fund activities to reduce electrical loads. Based on the last twelve months of market activity, the average value of these programs to the public is conservatively estimated at 7.5 cents per kilowatt-hour of load reduction, ignoring additional savings in ancillary services markets, transmission congestion relief, and reduced environmental impacts. Publicly funded load reduction programs have enormous potential benefits for California consumers.

Currently, however, these programs attain only limited public benefits. In order to achieve their full potential, programs should:

* Maximize load reductions, rather than focus on the current ill-defined "market transformation" which wrongly assumes that public benefits from load reductions are non-existent;
* Be administered by entities without interests in the supply-side or that otherwise do not benefit from higher electricity demand and prices, since the goal is to depress generation prices;
* Use cost/benefit criteria based on full public benefits.

Conclusion

If barriers to entry of new generation can be removed, efficient wholesale energy markets should continue to develop with time. However, individual consumer decisions appear unlikely to provide appropriate demand responsiveness to maximize public benefits of load reductions, which can now be estimated with some accuracy. Effective publicly-funded programs are needed to capture the large potential benefits of load reductions.

Figure 1
Public Savings from 1 MW Load Reduction
(width of bars exaggerated)

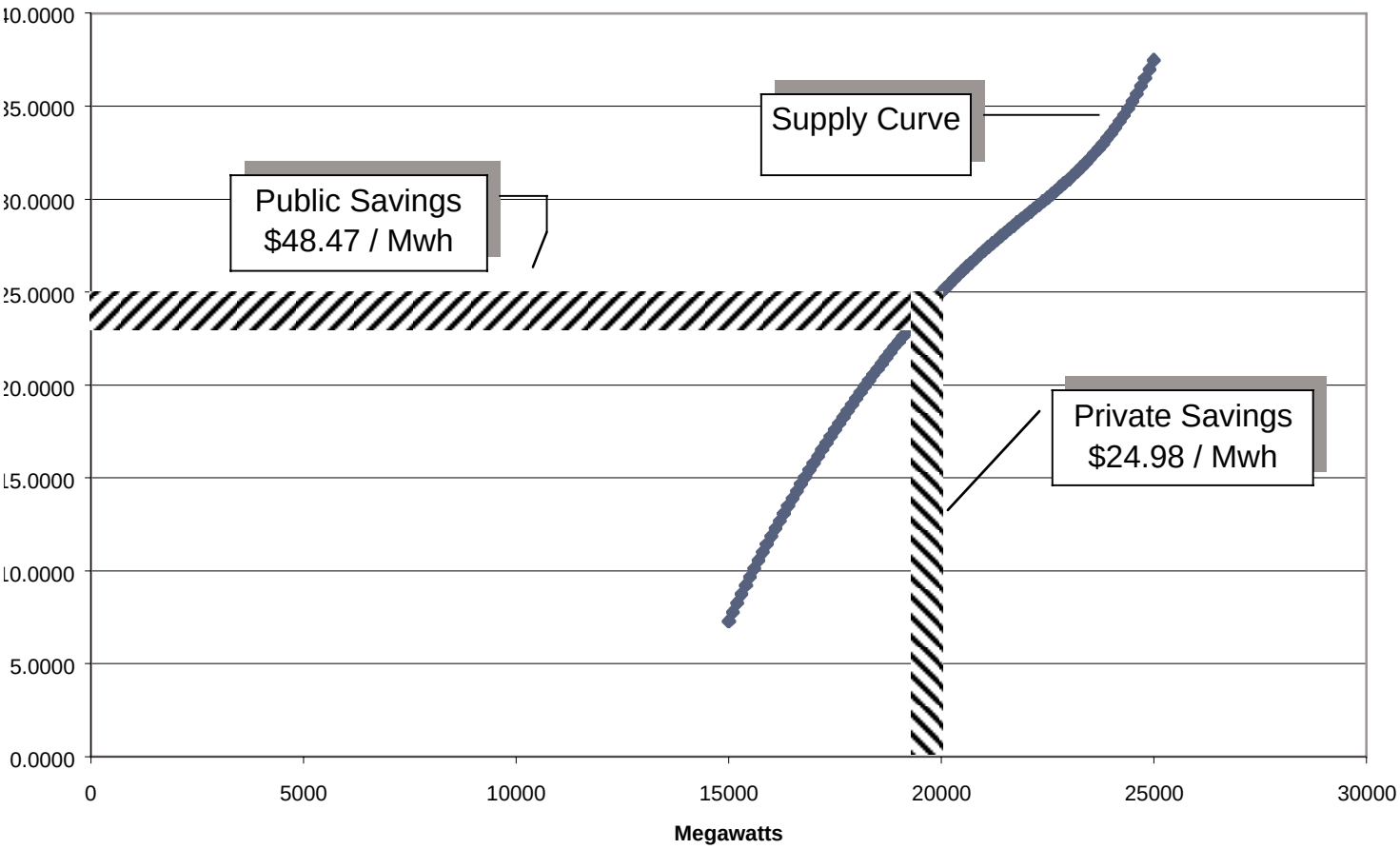

Figure 2
September, 1998

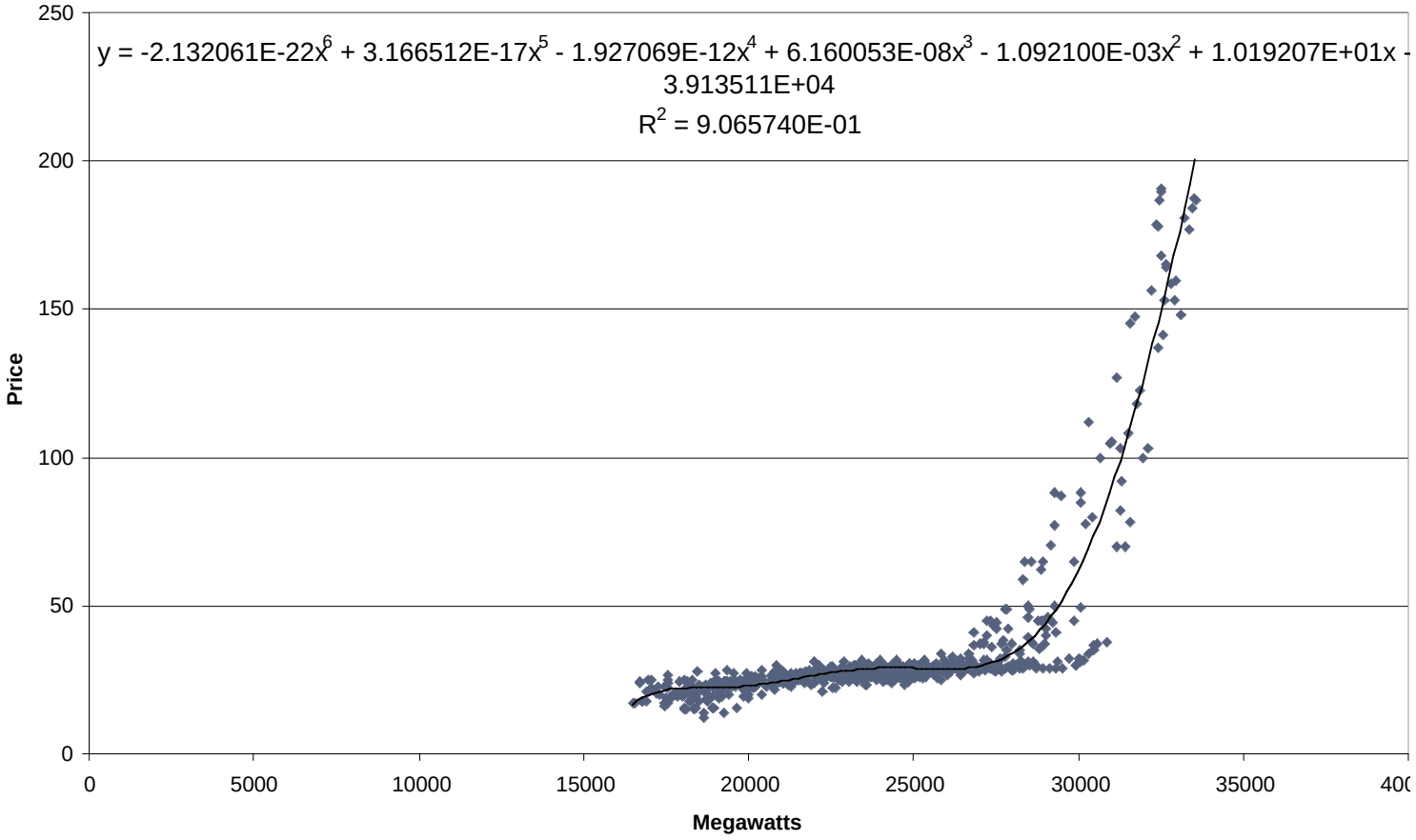

Figure 3
Cal PX Data for May 1999
with Fitted Supply Curve

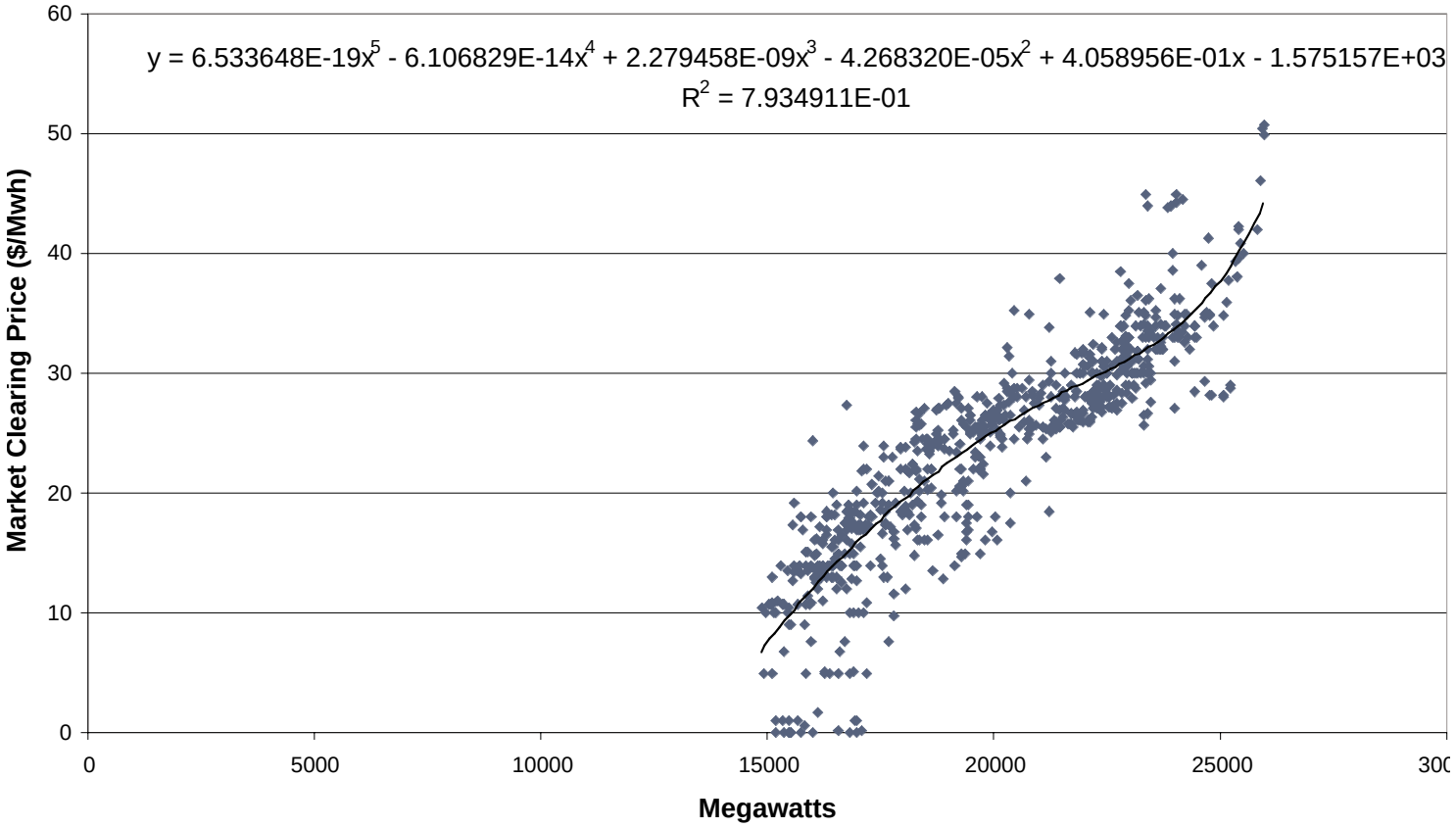

Figure 4
Price and Price Sensitivity
As Function of Load